



Additional chart coverage may be found in CATP2, Catalog of Nautical Charts.

## SECTOR 1 — CHART INFORMATION

# SECTOR 1

## STRAIT OF MALACCA—KO PHUKET TO PULAU PINANG

**Plan.**—This sector describes the E shore of the Strait of Malacca and off-lying islands from Ko Phuket to Pulau Pinang (Penang). The descriptive sequence is N to S and W to E.

### General Remarks

**1.1 Winds—Weather.**—Along the N coast of Sumatra, the SW monsoon prevails from about April to November and the NE monsoon from about November to April. During the SW monsoon the wind frequently holds both day and night near Ug Raya, while farther E it is not so permanent.

In the strength of the NE monsoon the wind blows from E to NE from about 10 in the morning to 4 in the afternoon, strengthening near the close. It then begins to drop, and is usually calm about sundown, and there is a land breeze during the night. In April SW and W winds begin, and the SW monsoon is established in May. Waterspouts are seen off the coast at times.

At the N and NE portion of Sumatra, during the NE monsoon, there is generally a swell on the coast, which gives rise to a considerable sea in the afternoon, if accompanied by a stiff sea breeze. Both subside quickly, so that the water is generally smooth at night and in the forenoon.

At times the monsoon blows strongly for some days, at which times communication with the shore is reported impracticable. December and January, are usually the worst months. The SW monsoon is the best for landing on this portion of Sumatra.

Although the Strait of Malacca is within the limits of the NE and SW monsoon of the Indian Ocean, on account of the high land on either of the strait, the winds are variable. However, land and sea breezes are regular on both coasts.

In the offing, the monsoons are regular when they are at their height in the adjacent sea; even then the wind is moderate in the strait, and only lasts during a part of the day. The monsoon becomes more regular near Singapore.

Between Ug Raya and Ko Phuket, the SW monsoon commences in the latter part of April or the early part of May, and ceases in October. In November there are calms and variables, and W winds frequently prevail.

The SW monsoon seldom blows far into the strait. In the middle of the strait during this season, variable winds, chiefly those from SE and SW, prevail with long calms. On the Sumatra side, light winds and calms prevail, and heavy squalls from the land are experienced during the night. On the Malaya side there are fewer calms and seldom any squalls. Variable winds or land and sea breezes are experienced.

During the SW monsoon the weather is generally cloudy and stormy, especially when the monsoon is at its height.

Sumatras or squalls from the SW are more common during the SW monsoon than in the NE monsoon. They generally blow during the first part of the night and are sometimes sudden and severe accompanied by thunder, lightning, and rain.

They are more frequently met with on the N coast of Sumatra and on the Malaya coast between Port Kelang and Karimum Island. They often blow for six or eight hours at a time as a strong or moderate gale. Their characteristic is that of an arch squall.

Northwesters are not so frequently felt as the Sumatras; they are most common during the SW monsoon and occur in the NW part of the strait between Ug Raya and North Sands, but sometimes blow through as far as Singapore Strait. These winds are sometimes severe at their commencement, but their strength soon abates. They are generally preceded by black cloud arch, which rises rapidly from the horizon toward the zenith. They are sometimes accompanied by lightning, thunder, and heavy rain.

The NE monsoon prevails in the W entrance of Strait of Malacca from November to April. The weather is more settled then and there are seldom any hard squalls. There is less thunder and lighting and much less rain than in the other seasons.

In November the winds are variable, frequently from the NW and W, although occasionally the NE winds set in November. From this period to March the NE monsoon is strongest, but at times NW and W winds of one or two days duration have been experienced in every month when the NE monsoon should prevail. Late in March the NE and N winds become light and variable, with strong land breeze at night. On the Malayan side these breezes commence between 8 and 10 in the evening and may last four or five hours, sometimes all night.

The E coast between Tanjung Jambuir and Belawan is not so much under the influence of the prevailing monsoon as the direction of wind. The broad plains at the foot of the high mountains being most favorable to the regularity of land and sea breezes. The wind is generally NE by day and SW by night all the year round on the coast. During the N monsoon, NE winds are most prevalent in January, February and March.

Northwest winds sometimes occur at night in February and March but they are infrequent compared with the winds from W and SW.

Throughout the year NW and SW winds are observed at uncertain periods for several days at a times and generally accompanied by fine weather. Sumatras are more frequent here than on the N coast.

Rain occurs in every month of the year in Sumatra. The period of greater or less rainfall on the N half of the island does not correspond with the period of the monsoons. There is, however, a certain regularity in the increase and decrease of the proportion of wet days in the course of the year.

The greatest rainfall on the N coast of Sumatra and the off-lying island usually occurs in the months of October and November. The rainfall on the off-lying islands is about double that on the N coast.

Off the E coast of Sumatra, the rainfall is heaviest in November and December.

At Ko Phuket in the N entrance to the Strait of Malacca, the monsoons are more regular than at the straits Settlements. The NE monsoon sets in December, with strong gales from the NE to NW, accompanied by lightning, and continues until March; this is the dry monsoon.

In March the monsoon is reported to be considerably weak, with occasional squalls. April is the change to winds from W to N, with heavy squalls.

The burst of the SW monsoon occurs early in May. It has fairly set in by June and heavy squalls and rain are frequent. It continues, with many days rain and as many days fine, until October. November is variable with heavy squalls from all quarters.

The maximum daily rain per month occurs in the month of August. In January and the early part of February there is little or no rain.

In Pulau Pinang, the prevailing winds from January to June are NE and NW. During the latter half of the year NW winds predominate.

**Tides—Currents.**—The Strait of Malacca to the W of the islands N of the N Sumatera coast, there is a current setting in a W direction, often attaining a rate of 1.5 to 2 knots, and inclining N or SW by the action of the prevailing monsoon.

Between these islands and the Nicobars, during the strength even of the SW monsoon, there is frequently a current that sets directly into the monsoon at a rate of 2 knots.

At the same period there is said to be a strong current between Pulau Weh and 6°30'N, setting E as far as the meridian of Tanjung Jambair. This current is said to continue all the year around, but with less strength during the NE monsoon. It is to be regarded as a countercurrent with reference to the W current along the coast from the Strait of Malacca.

Through the Strait of Malacca there is a constant NW set, but near the S, where the strait is considerably narrower, it is only felt by its action on the tidal current, decreasing the velocity of the flood current and almost overcoming it during neaps, and increasing that of the ebb to the same extent.

In the NW portion the same effect is produced near the shore on the tidal currents, but out in the middle of the strait it is fairly constant and strongest during the NE monsoon; it finally makes its way seaward along the coast and affects the tidal current there, as above mentioned.

The tidal action is not appreciable beyond the distance of about 8 miles off the Pedir coast and about 40 miles off the E coast of Sumatera.

The flood sets E on the N coast of Sumatera and the ebb W, rarely exceeding 2 knots at spring; at neaps they are sometimes imperceptible, except at the points or over banks and narrow channels.

The currents are also affected by the constant current out of Strait of Malacca, which takes a W direction along the N coast, through the passages S of Pulau Weh, so that for the greater part of the year the ebb current is longer and stronger than the flood current.

The prevailing winds as a result of which, when the water is rising or falling during the NE monsoon, there may be no E set for a day or more; conversely, the flood or E current runs long and stronger during the SE monsoon.

## Strait of Malacca

**1.2** The Strait of Malacca is defined as the area lying between the W coasts of Thailand and Malaysia on the NE and the coast of Sumatera on the SW side. Singapore Strait is the area lying between the S coasts of Malaysia and Singapore Island on the N side and the coast of Sumatera on the S side.

The Strait of Malacca and Singapore Strait together form the main seaway connecting the Indian Ocean with the South China Sea. The straits offer the shortest route for tankers between the Persian Gulf and Japan.

**Winds—Weather.**—The Strait of Malacca lies within the equatorial region of low atmospheric pressure and has a typical tropical climate. Typhoons are not experienced and gales are infrequent. The climate of the region is monotonous and the daily changes are more pronounced than seasonal variations. The temperature and humidity are high throughout the year. Waterspouts are common and when practicable a track well clear of them should be chosen.

The predominant winds over the Strait of Malacca are monsoon winds. The NE monsoon blows from November to March, reaching maximum strength and steadiness in January.

Normal wind strength is 5 to 10 knots, but may reach 20 to 25 knots for short periods in the N part of the strait. The sea area NE of Singapore Strait is exposed, while in the Singapore Strait, it tends to be less pronounced with light and more variable winds. The area between Sumatera and Thailand is well sheltered by the high ground to the E. The SW monsoon blows from May to September and reaches maximum strength and steadiness in July and August. Normal wind strength is about 10 knots, reaching 15 to 20 knots in the N approaches.

Squalls are common in the Strait of Malacca, the most significant of which occur between April and November and are referred to as Sumatras. These storms nearly always develop at night and usually last between 1 and 4 hours. These squalls are usually accompanied by thunderstorms and torrential rain. Winds mainly between SW and NW become strong and gusty, force 5 or 6, and may reach 7 to 8 for short periods. Southwesterly squalls occur in the N part of the Strait of Malacca during the SW monsoon. These squalls usually last longer than Sumatras and occur during day or night.

**Tides—Currents.**—The overall set in the strait is to the NW, but from May to September there is a tendency for SE sets to prevail in some N and central parts but the predominance is very slight. On the average, between 50 and 60 percent of all current observations in the strait are 0.5 knot or less. A small portion of these observations exceed 2 knots.

In the N part of the strait, the general directions of the tidal currents are SE and NW. The SE stream reaches maximum rate about 1 hour prior to HW and the NW stream reaches maximum rate about 1 hour before LW.

In the main fairway, the spring rates are about 1.5 knots, but may reach 2.5 to 3 knots in the more restricted channels and inshore waters.

The tidal currents in the S end of the Strait of Malacca set SE and NW to and from **Selat Durian** (1°00'N., 103°35'E.); they are not necessarily associated with any particular currents and may meet or separate from the latter S of **Tanjung Piai** (1°16'N., 103°31'E.), the S extremity of the Malay Peninsula.

**Depths—Limitations.**—The depths in the Strait of Malacca are generally irregular and a considerable portion of the bottom is of sandwave formation. Depths in the main shipping channels vary from 14.9 to over 100m.

Dangerous sandbanks which can restrict navigation are located in both traffic separation scheme lanes of **One Fathom Bank** (2°50'N., 100°55'E.) and **Fair Channel Bank** (1°28'N., 103°08'E.).

Surveys in the following areas are subject to sandwave formation: NW of One Fathom Bank and SW of **Tanjung Tuan** (Cape Rachado) (2°24'N., 101°51'E.).

Deep-draft vessels should therefore, take particular note of the latest depths over shoals lying in or near the fairway.

The height of tides vary with the locality in the straits as follows: In the vicinity of One Fathom Bank, it is 3.7m; off **Melaka** (2°12'N., 102°14'E.), 1.8m; off **Pulau Iju Kecil** (1°11'N., 103°21'E.) 2.6m; and in the vicinity of **Horsburgh Lighthouse** (1°20'N., 104°24'E.), 1.6m.

Between Melaka and Pulau Iju Kecil, the range is greater on the coast of Sumatera than on the Malaysian side. At the W entrance to the Strait of Malacca, the diurnal inequality is small, but it increases steadily E.

Since deep-draft vessels cannot avoid passing over certain shoal areas, an accurate prediction of the height of the tide is essential.

**Regulations.**—An IMO-approved routing system is in effect for the Strait of Malacca and Singapore.

It is comprised of Traffic Separation Schemes (TSS), a Deep-Water route, as well as specific rules for navigating through the straits.

**Caution.**—Navigational aids are often unreliable, especially in Indonesian waters. Risk of collision is appreciable due to heavy traffic using the through routes, frequent crossing traffic, and local fishing craft with nets.

Vessels are warned that local traffic, which could be unaware of the International Navigation Rules, may be encountered in or near the TSS. They should therefore take the necessary precautions which may be required by the ordinary practice of seaman or by the special circumstances of the case.

The above factors make navigation through the straits difficult, particularly for deep-draft vessels.

Additionally, reports continue to be received (1993) from vessels and authorities of attacks by armed thieves in the Strait of Malacca-Singapore Strait area, mainly in the vicinity of Philip Channel (1°00'N., 103°40'E.). The attacks are usually executed from fast power boats.

Navigation through the strait is affected by a number of factors which, when combined with the increasing density of traffic, the strength of the tidal currents, and the numerous shoals, makes navigation through the area difficult, particularly for deep-draft vessels.

## Ko Phuket

**1.3** The coast between Ko Phuket and Pulau Pinang, 180 miles SSE, is generally low with some hills near the mountainous island of Pulau Langkawi. Islands and islets project widely from the coast, fringed by a coastal bank covered by little water. The mouths of rivers are generally encumbered by bars.

Ko Phuket, which is part of Thailand, is separated from the Malay Peninsula by the narrow channel **Chong Pak Phra** (8°12'N., 98°17'E.).

Chong Pak Phra has a length of 12 miles and a width of about 0.4 mile at its W entrance. The land on both sides is mostly low and wooded with several villages along both shores of the channel. North of the channel are hills of moderate elevation.

**Tides—Currents.**—The flood tide sets in from both ends of Chong Pak Phra and meets about 3 miles E of the W entrance.

The current is weak in the middle of the channel, but at the W entrance, it sometimes attains a rate of 6 knots, and a velocity of 3 knots in the E entrance.

**Depths—Limitations.**—The depth on the bar at the W entrance to Chong Pak Phra is subject to great changes, varying from 1.8 to 5.5m. During the SW monsoon, the sea breaks across the W entrance, but during the NE monsoon, the water is smooth. Chong Pak Phra should only be used with local knowledge and by small craft. In the E entrance of the strait there are several islets, the inner most having a height of 92m.

**Anchorage.**—Good anchorage may be obtained by vessels with local knowledge, inside the bar at the W entrance, in depths of about 9.1m.

**1.4** The W side of Ko Phuket is indented by several bays with anchorage depths, but none of these bays afford shelter during the SW monsoon. The N part of this coast except for the first 7 miles, is low and wooded, and the hills immediately within it attain a height of 140 to 258m. Along the S part of the W coast is a range of mountains 305 to 559m high, densely wooded, and sloping gradually at its N and S ends.

**Ko Waeo** (8°02'N., 98°16'E.), two islets lying close together, are located 0.75 mile W of the N entrance point of Ao Bang Thao; the bay is entered 10 miles S of Chong Pak Phra.

**Ao Patong** (7°54'N., 98°17'E.), a bay shaped like a horseshoe, is entered between two rocky peninsulas. Several hotels exist along the bay's shores. A large hotel with a pier lies 2 miles E of the bay's S entrance point. No pilots are available.

Anchorage may be taken about 1 mile W of the bay's head, in depths of 17 to 19m over sand and mud bottom. The several bays on the W coast of Ko Phuket have suitable anchorage depths, but do not afford protection during the SW monsoon.

## Off-lying Islands South and East of Ko Phuket

**1.5 Ko Racha Yai** (7°36'N., 98°22'E.) is located 9 miles S from Ko Phuket and the NE end is low.

The cove located on the NW side of the island, has in its middle part a depth of 16.5m, sand. A small cove indents the N side of the island. Ko Racha Noi, located about 4 miles SSW of Ko Racha Yai, are two densely wooded steep-to islands nearly connected by a reef. The N island has a height of 176m. A reef extends 183m S from the S extremity of the S island.

Heavy overfalls are encountered in the passage between Ko Racha Yai and Ko Racha Noi. A group of small islands lies close S and SE of Ko Phuket. Ko Kao Yai is the island lying about 0.6 mile S of Lam Phra Chao, the S extremity of Ko Phuket. Ko Kao Noi, located 0.4 mile S of Ko Kao, is wooded and nearly as high as Ko Kao. A light is shown on Ko

Kaero Noi. Ko Hi, an island 186m high, lies 4 miles E of Ko Kaero Noi.

About 0.7 mile NE of Ko Hi is **Ko Waeo** (7°46'N., 98°24'E.) and 1.7 miles WNW of Ko Hi is Ko Bon, 57m high.

In the channels between the islands off the S side of Ko Phuket, the tidal currents set E and W at a rate of 1 to 3 knots.

**Ko Mai Thon** (7°45'N., 98°29'E.), located 6 miles ENE of Ko Hi, is wooded and 91m high. The N extremity of the island is low and sandy. Ko Doakmai, about 3 miles ENE of Ko Mai Thon, is a small island rising perpendicularly to a height of 67m. This island is steep-to. Ko Kai, a small wooded island, is located 8 miles E of Ko Mai Thon. It is steep-to, except on its E side, where there is a depth of 14m.

Ao Chalong, a shallow bay indenting the S side of Ko Phuket, is 5 miles wide in the entrance. Ko Lon, an island with a height of 267m, lies in the middle of the entrance. The channel on either side of Ko Lon can be used only by small craft.

During the SW monsoon small vessels can obtain anchorage in 6.9m, 0.3 mile N of Ko Lon.

**1.6 Laem Phan Wa** (7°48'N., 98°25'E.), the SE point of Ko Phuket, lies about 2 miles ESE of the E entrance point of Ao Chalong. A light is shown about 0.2 mile SW of the point.

**Ko Taphao Yai** (7°50'N., 98°25'E.), an island lying about 2 miles N of Laem Phan Wa, has a height of 112m.

A reef fringes the island, and a rock marks the SE extremity of this reef. Ko Taphao Noi, marked on its summit by a light shown from a white brick tower, lies 0.2 mile NE of Ko Taphao Yai.

**Caution.**—It was recently reported that the light on Ko Taphao Noi is obscured by trees and is difficult to see by day.

A 4.6m rocky patch, swept to a depth of 4.3m and marked on its NE side by a buoy, lies about 0.3 mile S of Ko Taphao Noi.

**1.7 Phuket Harbor** (7°49'N., 98°24'E.) (World Port Index No. 49770) includes the deep water Thaisarco Pier and the new Ocean Terminal situated close N of **Laem Kluei** (7°49'N., 98°24'E.) and the Shell Oil depot off Laem To Khun, about 0.5 mile further NNE.

**Winds—Weather.**—The NE monsoon occurs from November to March, while the SE monsoon occurs from May to September.

**Tides—Currents.**—Maximum tidal rise is reported to be about 3.5m. Tidal currents rarely exceed 2.5 knots, although a rate of 3 knots was reported (1998). The ebb current sets SW and the flood current sets NE.

**Depths—Limitations.**—The Thaisarco Pier extends E into the channel from Laem Kluei. The pier face is 60m long, with an alongside depth of 7.3m. The pier can accommodate a vessel with a maximum length of 113m and a maximum draft of 6.7m. The new Ocean Terminal lies immediately NNW of the Thaisarco Pier. The terminal provides two berths, with a total length of 360m and a minimum depth alongside of 9m.

Both berthing areas are approached from the SE through a 120m wide buoyed channel which has been dredged to a depth of 9m. A turning basin, 360m in diameter and also dredged to a depth of 9m, lies close N of the Ocean Terminal.

Vessels with a maximum length of 190m, a maximum beam of 25m, and a maximum draft of 9m can be accommodated.

Vessels are normally berthed and unberthed during daylight hours only.

The Shell Oil depot consists of two sets of mooring buoys lying between Laem To Khun and the W end of Ko Taphao Yai, about 0.1 mile E. The mooring buoys are 183m apart. The terminal is approached from the S on a range with a least depth of 7m; there is a least depth of 7m at the terminal.

Submarine pipelines extend from the berth to Laem To Khun. A channel marked by buoys and ranges extends NE from the oil depot, but the controlling depth in this channel is reported to be 4m.

**Pilotage.**—Pilotage is compulsory for vessels over 50m in length. Request for pilot should be sent 5 days in advance.

VHF contact should be made 3 hours prior to ETA on channel 16. Pilot boards close to the approach buoy. Messages can be sent through Pinang.

The pilot boards at the Fairway lighted buoy.

**Anchorage.**—Anchorage can be obtained in 5.4m in Phuket Harbor approximately 0.7 mile NW of Ko Taphao Noi Light.

Working anchorages for larger vessels loading and unloading cargo for Phuket and other parts in the vicinity are located during the NE monsoon season, about 2 miles E of **Ko Lipi** (7°57'N., 98°31'E.) in a depth of 11m.

At other times, anchor about 2 miles NE of **Laem Phap Pha** (7°52'N., 98°26'E.) in a depth of about 16m. Vessels up to 30,000 dwt have used these anchorages.

The bottom is reported (1996) to be sand and mud, good holding ground.

**Caution.**—Reports indicate that, due to inaccuracies in charted features, tangent bearings of Ko Taphao Yai, Ko Taphao Noi, and other points in the vicinity are unreliable.

It has been reported (1995) that channel buoys are now lighted and the port operates 24 hours.

**1.8 Tha Rua Phuket** (7°51'N., 98°25'E.) is a large bay entered between Laem Nam Bo and Laem Phap Pha, about 2.2 miles NE.

**Phuket** (7°53'N., 98°23'E.), the seat of the local government, is situated about 1 mile up a creek which discharges into the NW corner of the bay; the mouth of the creek is silted up. The town is a holiday resort with many hotels. A small drydock, 91m long and 24m wide, used for the repair and construction of tin dredges is on the NE side of the bay.

Anchorage for small vessels, with a depth of 5.5m, mud, lies 0.7 mile NW of the light on Ko Taphao Noi.

Cargo is reported to be loaded and unloaded from lighter vessels. Slight surf is present during E and SE winds. The depths in Tha Rua Phuket are subject to frequent change.

**Ao Tha Rua** (7°58'N., 98°26'E.), a shallow bay indenting the E side of Ko Phuket, is located 5 miles N of Tha Rua Phuket. Ko Maphrao, a 193m island, is located in the S part of the bay. A 38m rock lies 1.25 miles SE of Ko Maphrao. Ko Rang Yai, an island 81m high, lies 0.7 mile NE of Ko Maphrao, and the channel between them has a depth of only 3.2m.

Ko Rang Noi, immediately N of Ko Rang Yai, has a height of 55m. To enter Ao Tha Rua, vessels should pass first 0.5 mile E of Ko Rang Noi and then 0.5 mile N of this island. The only deep water available for anchoring is N of Ko Rang Noi and Ko Rang Yai, as farther W, the bay shoals rapidly. Ko Nakha Noi,

an island 65m high, lies 3 miles NE of Laem Yamu, the N entrance point of Ao Tha Rua.

Close N of Ko Nakha Noi is the much larger island of Ko Nakha Yai, 87m high; the channel between them is shallow. Between Ko Nakha Yai and Ko Phuket are several sunken rocks and a 64m islet. About 2 miles NW of this island are the islands lying in the E entrance of Chong Pak Phra. A 4.6m patch lies about 1.2 miles N of Ko Nakha Yai.

**1.9 Ko Yao Yai** (8°00'N., 98°36'E.), the S end of which is located about 9 miles E of the N entrance of Tha Rua Phuket, is a large island extending about 14 miles in a N and S direction. The island for its entire length is traversed by a range of mountains attaining a maximum height of 374m in its N part. The E coast of Ko Yao Yai is high and bold, and the NE coast of this island is low and sandy.

Foul ground with rocks above water, extends 1.5 miles E from the NE point of the island.

The S end of Ko Yao Yai is indented by a shallow bay. Laem Hua Lan, the E entrance point, is high, bold, and steep-to; a small island forms the W entrance point. Ko Khai Nok, a sandy island, 29m high, lies 4 miles W of the S end of Ko Yao Yai.

Two rocks, one 19.8m high, lies about 0.3 mile NNW of the island. They are connected by shallow depths, and 0.2 mile ESE of the island are two rocks above water. Ko Lipi, a conical 174m island, lies 3.5 miles N of Ko Khai.

Ao Labu, a bay about 3 miles wide in its entrance, indents the middle part of the W coast of Ko Yao Yai. The bay has depths of 9.1 to 2.7m, the greater depths being in the NW part of the bay. Hin Mu Sang Nua (Hin Musang Nua), a rock 2m high, marking a dangerous wreck 1 mile E, lies 3 miles NE of the S end of Ko Yao Yai and 2 miles off the E coast of the island.

Between Ko Yao Yai and Ko Phuket the tidal currents set N and S at a rate of 2 to 3 knots.

## Off-lying Islands

**1.10 Ko Yao Noi**, a large wooded island with a height of 242m in its N part, lies N of Ko Yao Yai, from which it is separated by a passage with a minimum width of about 0.5 mile and a least depth of 1.4m. A rock which dries to 1m lies in the middle of the channel approximately 0.4 mile NNW of the NE extremity of Ko Yao Yai. About 4 miles SE of the S extremity of Ko Yao Noi lies the small island of Ko Ngang.

Between 1.5 and 5 miles N of Ko Ngang is a group of high and steep-to islands, the S most being 158m high. Between this group of islands and Ko Yao Noi is a deep channel clear of dangers. About 1.7 miles E of the N end of Ko Yao Noi are two high vertical rocks and 1.25 miles farther E is a rock above-water.

Ko Phudu Yai (8°11'N., 98°39'E.), lies 0.3 mile NE of the N end of Ko Yao Noi. The depth between Ko Phudu Yai and Ko Yao Noi is only 3.2m. Ko Rei, a 166m island, lies 1 mile W of Ko Phudu Yai, and 1.25 miles NW of Ko Rei is Ko Batang, 152m high.

About 0.6 mile NW of the W point of Ko Yao Noi is Ko Boi Yai, having a height of 197m. Ko Boi Noi, a 146m island, lies 0.75 mile N of Ko Boi Yai, and between them are two small

islets. The entire area off the NW side of Ko Yao Noi is shallow and foul.

In the fairway E of Ko Yao Noi the flood current sets N and the ebb current S at rates of from 2 to 3 knots. The currents turn at about the time of H and LW by the shore.

**1.11 Ao Phangnga** (8°10'N., 98°35'E.), a large and shallow bay is 18 miles wide in its entrance between **Laem Som** (8°08'N., 98°26'E.), and a point (8°08'N., 98°44'E.) on the mainland. On the W side of the bay are numerous islands extending up to 3 miles offshore. The area within is foul. Four rivers discharge at the head of the bay.

## Islands in West and East Part of Ao Phangnga

**1.12 Ko Phanak**, located 4.25 miles ENE of Laem Som is the W entrance point of Ao Phangnga, has a height of 384m in its S part.

**Ko Raya Ring** (8°17'N., 98°30'E.), another large island, lies 4.5 miles N of Ko Phanak, and between them numerous islands. Khlong Krasom discharges about 1 mile NW of the N end of Ko Raya Ring. Ban Krasom, a village, is located about 5 miles up this river. Khlong Phangnga discharges about 2 miles NE of the N extremity of Ko Raya Ring. A drying bank extends 2.25 miles SSE from the E entrance point of the river.

Two islands, the SW of which is named Ko Nom Sao Noi, lie close together in a position 0.75 mile S of the E entrance point; the fairway is close W of Ko Nom Sao Noi. On the W side of the fairway abreast Ko Nom Sao Noi is a drying shoal with a length of 0.8 mile in a SE and NW direction. On the W side of the fairway, abreast the E entrance point, is another drying shoal.

**Phangnga** (8°28'N., 98°32'E.) is located 8 miles above the entrance of Khlong Phangnga.

**Directions.**—A vessel bound for Khlong Phangnga and having reached a position 1.5 miles E of Laem Phap Pha, the N entrance point of Tha Rua Phuket, should steer a mid-channel course between Ko Lipi and Ko Rong Yai, between **Ko Sup** (8°01'N., 98°32'E.) and Ko Nakha Noi, and between Ko Boi Yai and Ko Phanak. Only small vessels with local knowledge can proceed beyond Ko Phanak.

**Ko Mak** (8°17'N., 98°35'E.), is a wooded island 49m high, in the E part of Ao Phangnga.

**Ko Chong Lat** (8°16'N., 98°38'E.), lies 1.25 miles E of Ko Mak.

About 0.1 mile N of Ko Chong Lat is the small islet of Ko Ngam, and close N of the islet commences a narrow drying sandbank trending 4 miles N to the common estuary of the Khlong Pak Lao and Khlong Bo Saen.

**Ko Khlui** (8°14'N., 98°39'E.), an island 215m high, lies close S of Ko Chong Lat. Ko Pai, a 80m rock, and Ko Sum, a 65m rock, lie 1.5 miles W of Ko Khlui; these two high rocks are about 0.4 mile apart in a N and S direction.

**Anchorage.**—Anchorage in 8.7m is available 0.5 mile ENE of Ko Mak. Khlong Pak Lao and **Khlong Bo Saen** (8°22'N., 98°37'E.), flow respectively from E and N into a common estuary in the NE part of Ao Phangnga.

Two islands lie 1.5 miles SSW of the point separating the mouths of the two rivers. A bar with a depth of 2.4m

encumbers the entrance of Khlong Pak Lao, but within, the depths increase to about 6m.

**Directions.**—Vessels bound for Khlong Pak Lao from the S should pass E of Ko Yao Yai and Ko Yao Noi, then between Ko Khlui Malong on the E and Ko Sum and Ko Pai on the W, and finally between Ko Chong Lat and Ko Mak to the anchorage NE of Ko Mak.

## Southeastern Coast

**1.13 Laem Sak** (8°16'N., 98°39'E.), on the E side of Ao Phangnag is low, sandy and covered with trees.

**Ao Luk** (8°14'N., 98°41'E.), is the shallow bay SE of Laem Sak.

**Laem Taeng** (8°13'N., 98°43'E.), a bold point, is the SE entrance point of Ao Luk. From this bay the coast takes a S trend for 12 miles to Laem Hang Nak. Along the first 5 miles are several high rocky islets.

**Laem Hang Nak** (8°01'N., 98°46'E.), the NW entrance point of Ao Krabi which extends 14 miles SE to **Ko Pu** (7°51'N., 98°57'E.), is a rather low point.

Ao Krabi is a large bay with only its NW half of the entrance having depths of more than 9.1m. The greater part of the bay has depths of less than 5.5m.

Ko Bada, located from 3.5 to 6 miles SSE of Laem Hang Nak, is a large group of islands lying in the NW half of the entrance of Ao Krabi.

Khlong Krabi discharges through a common estuary in the NE part of Ao Krabi. All the estuaries are fronted by shallow and extensive sandbanks.

**Krabi** (8°04'N., 98°55'E.) (World Port Index No. 49780), is located about 2 miles up the Khlong Krabi. Vessels with a draft of 4m can reach the town at HW. The town has a wharf, and is a center for fish products.

Ko Pu, another large island, is located about 12 miles S of Krabi. The NW extremity of this island forms the SW entrance point of Ao Krabi.

## Off-lying Islands

**1.14 Hin Kong Nok** (7°50'N., 98°53'E.), a rocky patch with a depth of 4.1m, is located 3.5 miles W of the NW part of Ko Pu. Ko Mai Phi, a low islet, lies 8.5 miles W of Ko Pu, and 1 mile farther W is Ko Yung, 157m high.

Depths of less than 5.5m extend nearly about 0.7 mile NW and SW from Ko Mai Phi.

**Ko Phiphi Don** (7°45'N., 98°47'E.), the largest of the off-lying islands, is located 1.5 miles S of Ko Yung. This wooded island is about 335m high in the SW part. A bay is situated in the S part of Ko Phiphi Don with a depth of 20m in the middle.

**Ko Phraya Nak** (7°41'N., 98°46'E.), a high and bold island, lies 1 mile S of Ko Phiphi Don and the passage between them has depths of 25.6 to 27.4m. Two high islets lie 1 mile S of Ko Phraya Nak. Hin Bida, a rock awash and Ko Ma, a small islet, lie 3 and 6.8 miles, respectively, SE of Ko Phraya Nak.

Ko Klang, a large island separated from the mainland by a shallow stream, is also separated from the E side of Ko Pu by a channel with a least depth of 6.9m.

**Ko Lanta Yai** (7°35'N., 99°04'E.) and Ko Lanta Noi, close NE, are separated from the S side of Ko Klang by a narrow shallow channel. From seaward these islands appear as one.

The N part of Ko Lanta Yai is mostly flat and low-lying with several isolated hills. The S part consists of a narrow ridge of steep hills which attain an elevation of 491m.

**Tides—Currents.**—In the channel E of Ko Lanta Yai the tidal currents set N and S at a rate of 1 knot to 1.5 knots.

**Anchorage.**—During the NE monsoon there is anchorage SE of the S end of Ko Lanta Yai, in depths from 15 to 20m with soft mud. During the SW monsoon small craft with a light draft can anchor in 4.8m W of **Ko Po** (7°32'N., 99°07'E.), located 4 miles NNE of the S end of Ko Lanta Yai. Anchorage can be obtained in 7.8m about 2.2 miles ENE of the NE point of Ko Lanta Yai.

**1.15 Ko Ha Yai** (7°26'N., 98°54'E.), located 12 miles WSW of the S end of Ko Lanta Yai, is a group of five small islets. These islands are of a whitish color, bold and steep-to, and are difficult to distinguish at night. Ko Rok Nai and Ko Rok Nok, two islets close together, lie 14.5 miles S of the S end of Ko Lanta Yai. Both islets are wooded and steep-to. Ko Rok Nok, the SW islet, has a height of 238m. On the E side of this islet is a waterfall.

Hin Daeng, located 14 miles WSW of Ko Rok Nok, is a rocky patch of two rocks above water, one being about 3.9m high. These rocks are dangerous, hardly being visible during the SW monsoon. There is often a strong tidal current in their vicinity.

A bank with a depth of 25.6m lies 1 mile S of Hin Daeng. Ko Ngai, lies about 7 miles ESE of the S end of Ko Lanta Yai. Ko Muk, an islet with a height of 362m in its W part, lies 4 miles ESE of Ko Ngai; it is on the edge of the bank extending from the mainland. Ko Kradan, lies 3.5 miles SW of Ko Muk, has a steep-to W side. Hin Nok, a rock awash, lies 3.75 miles SE of Ko Kradan.

**1.16 Ko Talibong** (7°15'N., 99°24'E.), a large island, 320m high, lies about 7 miles SE of Ko Muk and 3 miles W of the common estuary of the Mae Nam Trang and the Khlong Palian. Hin Samphao Chom, two rocks awash, lies 2.75 miles SW of the SW end of Ko Talibong.

**Anchorage.**—During the NE monsoon good anchorage can be obtained in 11m about 2 miles 217° from the S end of Ko Talibong.

During the SW monsoon vessels should not seek shelter E of the S end of this island.

**Katang** (7°24'N., 99°31'E.) (World Port Index No. 49790) is located about 8 miles up the Mae Nam Trang. It can be reached by small craft drawing up to 3m.

**Directions.**—Mae Nam Trang and Khlong Palian are two rivers discharging through a common estuary about 3 miles E of Ko Talibong.

Small craft with a light draft and local knowledge can approach the estuary either N or E of Ko Talibong. Both approaches have a least depth of 2.3m, and in the area E of Ko Talibong are numerous dangers, some awash.

Ko Nok, a small islet lies 1.75 miles ENE of the E end of Ko Talibong. The channel through the bay E of Ko Talibong is buoyed. There is a light that is shown from Ko Nok.

## South Coast

**1.17** From the mouth of the Khlong Palian the coast trends S for about 22 miles, to **Laem Tanyong Lanai** (6°58'N., 99°41'E.) 94m high. It being higher than any in the vicinity, renders it conspicuous from seaward, presenting the appearance of an island. The coast being indented with several lights continues in a S direction, from Laem Tanyong Lanai to **Ko Khao Yai** (Tanjong Duri) (6°50'N., 99°42'E.).

The coast between Ko Talibong and **Pulau Langkawi** (6°22'N., 99°48'E.) should be approached with caution as this area is mostly unsurveyed.

## Off-lying Islands and Dangers

**1.18 Ko Liang Nua** (7°07'N., 99°25'E.) and Ko Laing Tai, forms the N extremity of the chain of islands, islets and rocks, 21 miles in length about 10 miles from the coast, which are almost continuous to **Ko Tarutao** (6°43'N., 99°38'E.).

Ko Liang Nua, the N most, is bold, precipitous and lies 6 miles S of Ko Talibong and forms the S side of the approach to Mae Nam Trang and Khlong Palian.

**Ko Bulaobot** (Goh Beng) (7°05'N., 99°42'E.) is a small islet located 3 miles SW of Ko Liang Tai. There is a light that is shown from Ko Bulaobot. Ko Phetra, the most conspicuous island in the vicinity, is located 5 miles SE of Ko Bulaobot.

The island is narrow, rocky and steep-to, except off the sandy beach on the E side. Ko Ta bai, 225m high is a steep islet lying 3 miles S of Ko Phetra.

**Ko Bulon Le** (6°50'N., 99°32'E.) is the outermost of the line of islands and rocks extending over 10 miles W from Ko Khao Yai. It is wooded, steep and rocky, except off the E side, from which shallow water extends 1.5 miles in a SE direction.

Ko Ahyum, 73m high, lies about 3 miles SW of Ko Bulon Le; two above-water rocks lie close W of the islet. To the SE and E of Ko Bulon Le, many patches of 5.5m and less are located as the depths in the vicinity are irregular.

Ko Khao Yai (Tanjong Duri), the largest of the group, is separated from the mainland by a channel about 0.1 mile wide.

**Tides—Currents.**—Between the mainland and the off-lying islands the tidal currents set towards and away from the coast at a maximum rate of less than one knot.

Off Ko Bulon Le they are similar in character, but the W current is the stronger, attaining a rate of over one knot. Off Ko Bulaobot the tidal current is rotary, changing direction regularly in an anti-clockwise direction, its rate, less than 0.5 knot, remaining fairly constant.

Off Ko Phetra the NE current, setting toward Mae Nam Trang runs from 5 hours before to 30 minutes before HW and the SW current from 30 minutes after HW to 5 hours after.

The maximum rate is about 2 knots, but at neaps the currents are weak and irregular.

**Directions.**—Vessels without local knowledge should pass W of Ko Phetra and between Ko Bulaobot and Ko Liang in

order to enter the approach to Khlong Palian and Mae Nam Trang, N of **Ko Liang Nua** (7°07'N., 99°25'E.).

## Southeastern Coast

**1.19** The coast SE of **Ko Bulan** (6°50'N., 99°41'E.), as far as **Ko Tammalang** (6°35'N., 100°00'E.), a distance of about 26 miles should be approached with caution. On the mainland, NE of Ko Khao Yai, there are a number of steep hills of moderate elevation. Two hilly points are situated 4 miles E of the island.

Along the coast to **Tanjung Po** (6°35'N., 99°57'E.) the elevation of the coast is low and consists mostly of mangrove swamps, through which many small streams are reported to flow into the sea. The entrances to these are often obstructed by shifting sand bars.

**Laem Mara** (6°44'N., 99°39'E.), the N extremity of Ko Tarutao lies about 6 miles SSW of Ko Khao Yai. The island is densely wooded and hilly, attaining an elevation of 721m in the middle part. Close off the E side of Ko Tarutao is a channel through which a depth of not less than 8.0m may be found.

**Talo Wao** (Wanderer Bay) (6°36'N., 99°41'E.) is located on the E side of Ko Tarutao and is entered between Ko Pulau Na and Ko Klang, lying 1.5 miles to the S. The bay is exposed to the NE monsoon.

**Tides—Currents.**—Between Ko Tarutao and the mainland, the tidal current sets NW from 1 hour after until 6 hours before HW at Pinang (Penang). At neaps, the tidal current is almost negligible.

**Anchorage.**—Good anchorage can be taken in Talo Wao in 5m about 0.1 to 0.2 mile NW of the N extremity of Ko Klang.

The anchorage should be approached with a prominent rock, 59m high, with white patches on the seaward side, on a line bearing 250° and anchorage taken when the N extremity of Ko Klang bears 130°.

## Butang Group

**1.20 Butang Group** (6°32'N., 99°15'E.) is wooded and appears as one large island from a distance. The group is uninhabited except for a small fishing village at the E end of Ko Nipit, the S most island. It is reported that the group was a good radar target up to 25 miles distance.

A light is shown from an island located about 1 mile S of the E extremity of Ko Butang.

Ko Adang, the E most of the two large islands, has a long sandy beach on the W side, fronted by a coral reef which extends 183m off. A mountain on the S side of the island is conspicuous from all directions.

**Anchorage.**—During the NE monsoon, the best anchorage is in about 27m, sand, 0.5 mile W of the SW end of Ko Adang.

During the SW monsoon, the only protected anchorage is NE of Ko Butang in a depth of about 22m, approximately 0.4 mile offshore.

**Ko Tanga** (6°34'N., 99°27'E.) 198m high, lies about midway between the Butang Group and Ko Tarutao, and is formed by two portions connected at LW by a reef. The island is thickly wooded and steep-to, except on the E side, which is fringed by a narrow reef. A light is shown from about 0.3 mile E of the S extremity of Ko Tanga.

**1.21 Pulau Langkawi** (6°22'N., 99°48'E.) about 15 miles wide, is mountainous, densely wooded and formed and flanked by towering masses of limestone.

**Selat Chinchin** (Langkawi Sound) (6°28'N., 99°40'E.) is the channel 4 miles wide between the S end of Ko Tarutao and the N coast of Pulau Langkawi. The channel trends SE around the NE side of Pulau Langkawi and is bounded on the NE side by the coastal bank off the coast of Thailand.

The E coast of Pulau Langkawi is rocky, but there are a few sandy beaches. A chain of islets lies SW of **Pulau Chorong** (6°19'N., 99°56'E.) the E most island of the group.

The W coast of Pulau Langkawi S of Tanjung Chinchin to Tongung Belua, 4.5 miles S, is rocky and steep-to, with a few sandy beaches, backed by precipitous hills covered with jungle.

The bay SE of Tanjung Belua to **Pulau Borau** (6°18'N., 99°42'E.) is fronted by a long sandy beach, backed by low lying land and small hills.

**Tides—Currents.**—The tidal currents in Selat Chinchin are irregular and influenced by the monsoons. During the NE monsoon rates of 2 knots setting WSW have been experienced.

Depths in the channel are regular, shoaling gradually ENE and towards each side, with depths of over 18m in the fairway.

**Anchorage.**—Sheltered anchorage exists in the middle of **Teluk Datai** (6°26'N., 99°40'E.), in depths of 5m, mud. The bay is free of dangers and is backed by a sandy beach. A good anchorage exists 1.5 miles SW of Tanjung Kemarong, in a depth of 11m, mud.

**1.22 Pelabuhan Bass** (Bass Harbor) (6°19'N., 99°50'E.) (World Port Index No. 49830) formed between the S coast of Pulau Langkawi and the N coast of Pulau Dayang Bunting, is 7 miles in length with an average breadth of 1.5 miles and a general depth of 5.5 to 7.5m, mud bottom.

From **Tanjong Sawa** (6°16'N., 99°44'E.) the coast trends NE for 6.5 miles to a long sandy beach, being a succession of rocky points with sandy bays between them, and backed by hills.

Along this coast are few villages; the principal being Kuah, on the E side of the head of the harbor.

The limits of the port comprise the water area between 6°19'40"N, and 6°13'30"N, and between 99°52'52"E, and 99°46'22"E.

**Tides—Currents.**—It is HW, full and change, in Selat Dayang Bunting (Tyson Strait), at 0 hour; springs rise 2.4m.

The flood tide runs to the S out of Pelabuhan Bass (Bass Harbor) from 0.5 to 1 knot, and the ebb current the reverse way.

In the offing, the currents generally set to the N during the SW monsoon, and to the S during the NE monsoon. Caution is advised as cross sets are usually experienced off the entrances of the various channels.

**Aspect.**—The E entrance of the harbor is known as Selat Kuah. The W entrances, Selat Dayang Bunting and that N of Pulau Kentot Besar (Pulau Singha Kintut) have apparently not less than 7.3m, which is found on the bar stretching E of Tanjong Sawa. They are available for craft with local knowledge.

**Anchorage.**—Small vessels can anchor in 7.3m of water in Pelabuhan Bass. Deep-draft vessels may anchor N of **Pulau Singa Kechil** (6°15'N., 99°45'E.) 97m high, about 0.2 mile E of an islet which is almost connected with the N extremity of Pulau Singa Kechil bearing 178°, distance 0.5 mile is a good anchorage in a depth of 17.4m, mud.

**Caution.**—The following dangers lie on the W entrance of Pelabuhan Bass (Bass Harbor): A reef, about 0.1 mile in extent and drying in places at half ebb, N of the fairway of the SW entrance of Pelabuhan Bass, with the E extremity of Pulau Kentot Besar (Pulau Singha Kintut), bearing 242°, distance about 2 miles. A small reef with a depth of about 0.6m at LWS, is located 018° from the above reef at a distance of about 0.4 mile. Vessels should pass S of these dangers.

It has been reported (1995) that uncharted obstructions and depths less than charted exist within 2 miles of the coasts of Pulau Langkawi.

**1.23 Paknam Satul** (Pak Nam Satun) (6°30'N., 100°05'E.) lies about 10 miles NE of Pulau Langkawi and is well sheltered by the islands from the SW monsoon. Kuala Perlis (Sungai Perils) lies about 7 miles SSE of Paknam Satul; coasting vessels anchor off it in 5.5m of water SW of a group of four islands. A mud flat fronts the coast.

**Sungai Kedah** (6°06'N., 100°17'E.), the river entrance which is about 20 miles S of Kuala Perlis, is shallow. The N entrance point of Sungai Kedah is marked by a light.

There is an outer anchorage, in about 7m, 3 miles off Sungai Kedah entrance.

**Alor Setar** (Alor Star) (6°07'N., 100°20'E.) (World Port Index No. 49840), the capital of Kedah State, is situated approximately 7 miles above the mouth of the Sungai Kedah.

There are no deep-water berthing facilities reported in this port. Gunong Keriang, 213m high, is an isolated and conspicuous mass of limestone, honey-combed with caves, located about 5 miles NE of Sungai Kedah entrance, and is a good mark for making that river.

## Off-lying Islands

**1.24 Pulau Segantang** (6°03'N., 99°56'E.), consisting of two rocky islets 25m high, lies about 22 miles W of Sungai Kedah and 10 miles SE from the S extremity of Pulau Dayang Bunting.

There are depths of 29.3m close to its N and E sides, and 34.7m 2 miles SW. No dangers are reported in this area.

**Pulau Paya** (6°04'N., 100°02'E.) lies 6.5 miles E from Pulau Segantang, 88m high, is densely wooded and steep-to, except for part of the NE side. Pulau Lembu, 73m high, lies 0.5 mile NE of Pulau Paya. A rock awash lies about 0.1 mile to the N.

In the channel between these two islands lies Pulau Kaca, a rock 26m high. Near the islands of Pulau Paya and Pulau Lembu there are, with the exceptions mentioned, depths of 23.8 to 29.3m within 0.5 mile of the islands.

**Pulau Perak** (5°41'N., 98°56'E.), is a barren, white rock 115m high. The rock lies nearly midway in the Strait of Malacca, between Sumatera (Sumatra) and Sungai Kedah. It is steep-to, with depths of from 73.1m to 91.4m within a short distance. Pulau Perak is often taken as a point of departure, and when the weather is cloudy during the SW monsoon it is

frequently the first land seen after entering the Strait of Malacca from the N.

## South Coast

**1.25** From Sungai Kedah the coast, with an adjoining mud flat, extends in a S direction for a distance of about 26 miles to the entrance of Sungai Merbok (Merbau River), and continues low and wooded until within 8 or 9 miles of that river, where the conspicuous Gunung Jerai, 1,212m high, is located at a distance of 4 miles from the coast, in 5°47'N, 100°26'E.

Bunting Islands consist of 4 small islands located about 14 to 21 miles S of Sungai Kedah entrance, and lie 1 to 4 miles off the mainland.

Sungai Merbok (Merbau River), the entrance to which is formed between the low coast on the N and the hills to the S, is fronted by the coast mud flat, which has depths under 5.5m, and extends nearly 3 miles to seaward. There is a depth of 2m on the bar, with depths of 5m within. Small craft drawing 2m can proceed about 3 miles upstream at HW.

**Sungai Muda** (5°34'N., 100°21'E.), is located about 6 miles S of the Sungai Merbok entrance. It is obstructed by a sandy bar which dries from 0.6 to 1.2m at LW.

Small craft, drawing 1m, can enter at half tide and proceed about 4 miles upstream.

**Caution.**—In passing between Sungai Kedah and Pulau Pinang (Penang Island) during the night, care must be taken to keep clear of the numerous fishing stakes which are fixed in places on the banks, some 6 or 7 miles from the coast.

## Pulau Pinang

**1.26** The island of Pulau Pinang is separated from the mainland by a strait 1.5 to 7 miles wide, which affords sheltered anchorage. The N part of Pulau Pinang is mountainous, and through the center of the island runs a range of hills, declining in height as it approaches the SW extremity.

**Western Hill** (5°26'N., 100°15'E.), the highest point of the island, is 834m high, a short distance to the E is Government Hill. The W side of the island is low and wooded.

The N side of Pulau Pinang is much indented, except near its NE extremity, and fringed by a shoal area with depths of less than 5.5m extending as far as 2 miles offshore.

## Pinang Harbor (5°25'N., 100°21'E.)

World Port Index No. 49850

**1.27** Pinang Harbor is one of Malaysia's largest ports and handles most of the trade for the cultural, industrial, and agriculture regions of Northern Peninsular Malaysia. The port complex includes facilities on Pulau Pinang at Georgetown and on the mainland at Butterworth and Perai. Pinang Harbor has ample, modern, alongside berthing facilities for all classes of vessels.

**Winds—Weather.**—Pinang Harbor is subject to the NE and SW monsoons, with high temperature, humidity, and rainfall throughout the year. Winds are generally light or moderate in both seasons. The usual weather pattern is for partly cloudy mornings inland with showers and thunderstorms by the

middle of the afternoon and dispersing at night. Sumatras can be expected from April to November with an average occurrence about 3 to 4 per month.

**Tides—Currents.**—At springs the tidal currents run at a rate of from 2 to 3 knots through the harbor anchorages (although rates of up to 5 knots have been observed), but less in the approaches, and continue to flow N or S for about 1 hour to 1 hour 30 minutes after L or HW.

During the NE monsoon the tidal currents are regular, the S current running from about 4 hours before to about 2 hours after HW by the shore; the N current during the remaining period. Off the entrance to North Channel a S current of 0.5 knot has been experienced. In November the current sets round **Muka Head** (5° 29'N., 100° 11'E.) and overcomes the outgoing current, sometimes for 2 or 3 days.

The main ship channel into Pinang Harbor is via the North Channel which is 10 miles in length, has a width of 183m and a least depth of 10.2m. Approaches to the harbor are well marked by navigational aids. Approach depths gradually increase from 11 to 22m, S of buoy "Tokong."

**Depths—Limitations.**—Shoaling to a least depth of 9.7m has been reported in some areas of the North Channel. The approach to Pinang Harbor via the South Channel is restricted to vessels with a 6m draft and a height of 28m due to the vertical clearance of Pinang Bridge. A least depth over the bar of South Channel is 5.8m.

Pinang is equipped with modern wharves, piers, and basins to handle practically any cargo that can be transported on water.

These include facilities for container, ro-ro, dry and liquid bulk carriers, general cargo and passenger vessels.

Swettenham Pier is situated on Pinang Island, which has two linear berths with a total length of 366m, with a depth alongside of 10m.

It handles breakbulk cargoes as well as passenger and naval vessels.

On the mainland, Berths 1-6 are the Butterworth Wharves, with Berths 1-4 being used for conventional cargo with a length of 717m and depths of 8.9m alongside.

Container facilities are situated at berths 5 and 6 with a total length of 322m. Berth 6 is also equipped with a ro-ro ramp of 8m wide and 28m long.

Berth 9 is the Vegetable Oil Tanker Berth with a depth of 8.9m and is located just S of Butterworth Pier No. 1; vessels up to 167m in length can be accommodated.

A T-head pier, with about 320m of berthing, extends W from a point on the shore, on reclaimed land about 1 mile N of Berth No. 8, and is best seen on the chart.

A bulk cargo terminal, for both liquid and solid cargoes, is situated at Perai. The terminal consists of two main berths 338m long with a depth of 10m alongside and one inner berth with 154m long with a depth of 7m.

Vessels of more than 5m in height or 30m in length must obtain written permission from the Port Officer, Pinang, before entering the restricted area, the limits of which are shown on the chart.

**Aspect.**—The coast of the mainland being low does not show up well from North Channel as that from Pinang Island, consequently the latter will usually appear nearer when in the fairway between them. Within the harbor limits of Pulau

Pinang, Fort Cornwallis, with a conspicuous flagstaff, 5.7m high lies on the NW entrance to the harbor. On the mainland, two conspicuous radio masts lie on the E entrance of the harbor. Numerous other prominent buildings and masts stand on the island and mainland.

**Pilotage.**—Pilotage is compulsory for vessels 200 grt and over when berthing and unberthing in the harbor, except fishing vessels. Vessels should send ETA 3 hours in advance to Pilots Pinang stating their ETA at North Channel Light Float or, in the case of South Channel, ETA at Pulau Rimau.

The maximum draft of the vessel should also be included. Pilot should be contacted on VHF channel 12.

For vessels entering the harbor through the North Channel, the pilot boarding area is NW of the North Channel Light Float.

For entry through the South Channel the pilot will be embarked in the vicinity of Rimau Buoy.

An outer anchorage is charted about 2 miles SSW of North Channel Light Float.

**Anchorage.**—Anchoring is prohibited within the indicated cable area on the NE side of North Channel.

Numerous anchorages including Naval, Petroleum, Quarantine, Local, Small Craft, and Explosive exist within harbor limits and are best seen on the chart.

**Caution.**—Fishing stakes extend all around Pulau Pinang and the mainland coast within the 10m contour line. Bamboo poles, singly or in groups, marking fishing nets or pots may be encountered in this area. Large numbers of fishing boats may be encountered in the vicinity of, and NW of **Muka Head** (5°28'N., 100°11'E.).

**1.28** Great Kra Flat forms the E side of South Channel, it fronts the shore at various distances from Sungai Perai, 18 miles N. It encumbers much of the South Channel. Pulau Rimau is nearly 5 miles in breadth, it is dry in places at LW, and tapers to a point off Sungai Perai.

A channel, with depths of 5.8 to 15.5m, lies E of this extremity, leading to the Sungai Perai, Juru, and Jajawi Rivers.

Outer Kra Bank lies SW of Great Kra Flat, the N end lies about 9 miles WNW of **Tanjong Piandang** (5°05'N., 100°22'E.). A dangerous wreck lies about 5.2 miles, 239° from the N portion of Outer Kra Bank.

Pulau Jerejak on the W side of South Channel is located about 4 miles NNE of Pulau Rimau. A 6.7m shoal lies about 0.7 mile NE of the S end of Pulau Jerejak. Between the W side of Pulau Jerejak and Pulau Pinang there is a least depth of 4m in the fairway.

Middle Bank extends N from Pulau Jerejak for a distance of 4.75 miles. Its N end tapering to a point with depths under 5.5m to abreast Pinang.

Between Middle Bank and the mud bank fronting Pulau Pinang, is the narrow Western Channel with a depth of about 5.5m. The channel is reduced to about 114m in width abreast the W side of Pulau Jerejak.

A curved spit, with a least depth of 4m, extends from the shore into the channel.

Syrang Bank lies E of Middle Bank, a portion of which dries. Fronting Middle Bank, it forms the W side of South Channel for a short distance.

East and SE of Syrang Bank, and in the channel are several detached patches with from 3.7 to 5.5m. Sungai Perai is located 2.5 miles SE of Pinang, and E of the N end of Great Kra Flat.

The rivers Sungai Perai, Sungai Juru, Sungai Jajawi, and Kuala Tengah exit on the coast abreast Pulau Pinang.

**Caution.**—Less water than charted has been reported (1996) on Outer Kra Bank.

Care must be taken to avoid the wrecks off the W side of Outer Kra Bank and not to confuse the various lighted beacons on the N part of Great Kra Flat.